ISSN 1819-1878

Asian Journal of Animal Sciences

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OPEN ACCESS Asian Journal of Animal Sciences

ISSN 1819-1878
DOI: 10.3923/ajas.2016.182.188

Research Article
Chemical Composition of Scavenging Feed Resource of Indigenous Chickens

N. Hayat, D. Solomon and M. Meseret

Jimma University College of Agriculture and Veterinary Medicine, P.O. Box 307, Jimma, Ethiopia

Abstract
The study was conducted to evaluate the chemical composition of scavenging indigenous chickens feed resource base in three kebeles from Seka Chekorsa district of Jimma Zone during the dry period. A total of 60 chickens were randomly selected at the end of the scavenging hours, slaughtered and eviscerated for physical examination and crop content analysis. The crop content was subjected to chemical analysis. The results revealed that the indigenous chickens feed resource contain, cereal grains (38%), kitchen wastes (15%), green forage (17%) and insects/worms (30%) showed variation among individual birds slaughtered. The mean fresh weight of crop contents was about 22 and 20 g for pullets and cockerels, respectively, with the corresponding mean dry matter content of 94±0.71 and 92±0.4%, respectively. The mean percentage composition of crude protein, ether extract, crude fiber, nitrogen free extract and total ash of the crop content was 10.46±2.63, 4.11±0.55, 11.92±5.19, 22.86±3 and 44.73±7.8, respectively for pullets and 9.16±1.58, 3.74±0.71, 11.07±7.63, 22.15±2,47 and 46±9.82, respectively for cockerels. Calcium and phosphorus content of the crop content was found to be 1.26±0.59 and 0.66±0.13 for pullets and 0.73±0.32 and 0.68±0.04 for cockerels, respectively. The metabolizable energy of the crop content was 2023±397.6 and 2082.8±854.5 kcal kg^{-1} DM for pullets and cockerels, respectively. Therefore, the scavenging feed resource of indigenous chickens in the district is inadequate in quantity and deficient in all the nutrients required. Consequently, supplementary daily basic poultry ration required to enhance poultry production in the district.

Key words: Chemical composition, indigenous chickens, rural poultry, scavenging feed resource

Received: November 20, 2015 Accepted: January 01, 2016 Published: April 15, 2016

Citation: N. Hayat, D. Solomon and M. Meseret, 2016. Chemical composition of scavenging feed resource of indigenous chickens. Asian J. Anim. Sci., 10: 182-188.

Corresponding Author: N. Hayat, Jimma University College of Agriculture and Veterinary Medicine, P.O. Box 307, Jimma, Ethiopia

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

In Africa, village poultry contributes over 70% of poultry products and 20% of animal protein intake (Kitalyi, 1998). Village poultry of indigenous chickens is one of a number of integrated and complementary farming activities contributing to the overall well-being of the households throughout Africa. The indigenous chickens are a valuable asset to local populations as they contribute significantly to food security, poverty alleviation and the promotion of gender equality, especially in disadvantaged groups and less favored areas (Gueye, 2000; Moges and Dessie, 2010). Ethiopia is not exception to this situation.

The current estimates of Ethiopian poultry population is about 34.2 millions with native chicken of none descriptive breeds representing 94.4%. These are kept under traditional management system, which is characterized by small flock sizes, low input and output and periodic devastation of the flock by disease. The low productivity of the indigenous chickens could be attributed to lack of genetic improvement, incidence of diseases and predation and management factors (Sonaiya, 2002; Molla, 2010). Besides, there is no planned feeding of chickens under the traditional village production system in Ethiopia and scavenging is almost the only source of diet for the chickens, indicating that the size and productivity of the village flock ultimately depend on the household waste and the availability of scavenge able feed resources.

Scavenging Feed Resource Base (SFRB) is defined as those feed resources available at farm level that consists of household refuse and all the materials available in the immediate environment that the scavenging birds can use as feed (Goromela *et al*. 2006). It depends on the number of chickens per households, the types of food crops grown, methods of cultivation and food processing and the climatic conditions that determine the rate of decomposition of the food products. The availability of the scavenging feed resource is affected by seasonal fluctuations and the village poultry production mainly depends on a large degree on the quality and quantity of feed available from scavenging (Dessie and Ogle, 2000; Molla, 2010). Therefore, a conscious effort needed to improve the nutritional status of the scavenging indigenous chickens feed resources and flock dynamics across the different seasons and agro-ecologies of the country have paramount importance. Cognizant to this fact, this study was designed to assess the adequacy and chemical composition of scavenging feed resource of indigenous chickens in Seka Chekorsa district of Jimma Zone.

MATERIALS AND METHODS

Description of the study area: This study was conducted in Seka Chekorsa, Jimma Zone, Oromia Regional State. It is located at 358 km Southwest of Addis Ababa (Fig. 1). The altitude of Seka Chekorsa district ranges from 1580-2560 m

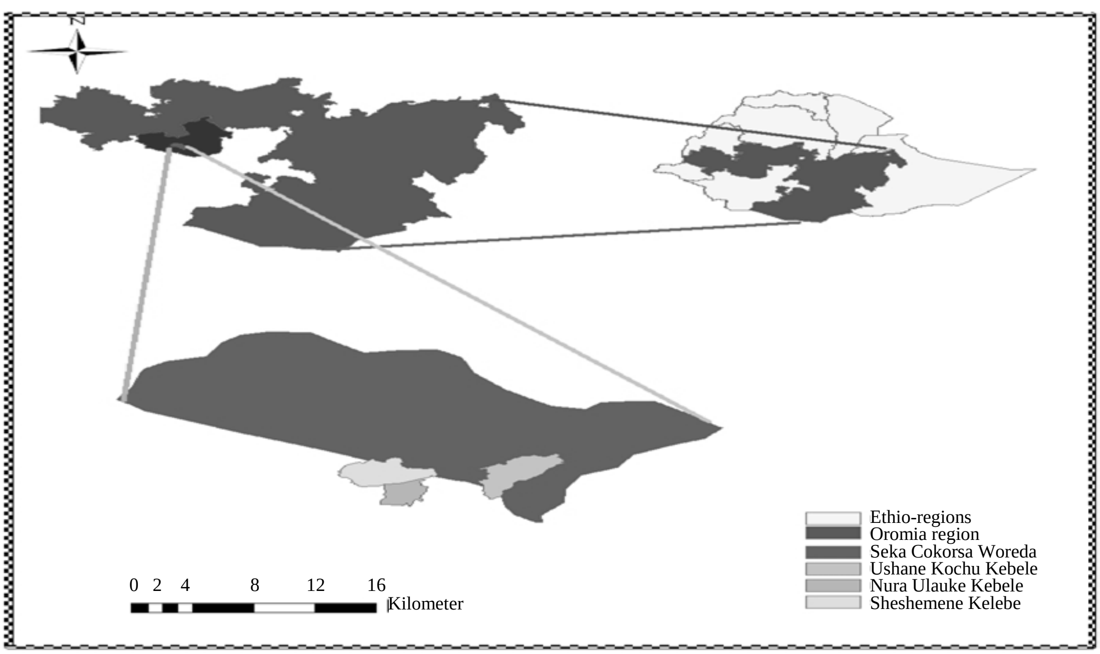

Fig. 1: Map of Seka Chokorsa district with the selected Kebeles

above sea level. An agro-ecological setting of the district comprised of highlands (15%), midlands (67%) and lowlands (18%) and the area receives good rainfall, ranging from 1,200-2,800 mm per annum. The annual rain fall is evenly distributed with very low seasonal and area- wise variability (IPMS, 2007). March to early May characterizes the small rainy season (planting time for major crops) and the big rainy season extends from June to October. Mean monthly temperature varies between 12.6 and 29.1°C (IPMS, 2007).

Management of experimental chickens: Seka Chekorsa district comprises of 36 administrative Kebeles (Kebele is the smallest administrative unit in Ethiopia). Three Kebeles namely (*Shashemene*, *Ushani Kochi* and *Nura Ulauke*) from the district was selected. The selection based on chicken population and accessibility. The total 30 households keeping indigenous chickens were randomly selected from three Kebeles (ten from each). Arrangements were made with the total of 30 selected participating households for the purchase of the experimental chickens. The total of 60 chicken (30 pullets and 30 cockerels with mean weight of 1.12 and 1.4 kg, respectively) at an age of 3-5 months were purchased on the basis of their physical appearance and informations provided by the participating households. The chickens were collected directly from the households. The chickens were slaughtered and eviscerated. The crop content of each bird was weighed, visually examined, categorically sorted out and quantified.

Laboratory chemical analysis: The sampled birds were carefully slaughtered and eviscerated. The crop content of individual birds was visually observed and sorted out into different categories. The crop contents of each bird were weighed individually using an electronic balance (±0.001 g). The crop content was sort-out categorically to determine the percentage of each feed ingredients. The fresh crop contents collected were weighed and oven dried at 65°C for 72 h. The oven dried materials were milled (ground) to pass through 1 mm screen and stored in tight plastic bags until required for laboratory chemical analysis. The total Dry Matter (DM), Crude Fiber (CF), Ether Extract (EE), Crude Protein (CP), Nitrogen Free Extract (NFE) and total ash were determined according to AOAC (1990). Calcium (Ca) and phosphorus (P) were determined with the use of atomic absorption and spectrophotometer (model and make can be included) (FAO, 1980). The True Metabolizable Energy (TME) of the dry crop contents was estimated using the following formula (Wiseman, 1987), with the assumption that TME is 8% higher than ME (Rashid *et al*., 2005).

$$\text{TME (kJ kg}^{-1}\text{ DM)} = (3951 \pm 54.4\text{EE}-88.7\text{CF}-40.8\text{Ash}) \times 4.184$$

Where:

EE = Percentage composition of ether extract on DM basis
CF = Percentage composition of crude fiber on DM basis
Ash = Percentage composition of total ash on DM basis

Statistical analysis: Data collected from laboratory chemical analysis was analyzed using the General Linear Models (GLM) procedure by using SAS statistical software packages (SAS, 1999). The 5% significant level was considered.

RESULTS AND DISCUSSIONS

Crop content: The weight of the experimental chickens and their respective crop contents are given in Table 1. The mean live weight of the indigenous pullets and cockerels used in the study was 1.12 and 1.4 kg head^{-1}, respectively. The result revealed that the mean live weight of the experimental pullets was significantly lower (df = 1, $p<0.005$) than the mean live weight of the cockerels. The result of this study seems to be in agreement with that of AACMC (1984) which reported that local males may reach 1.5 kg live weight at 6 months of age and females about 30% less. Teketel (1986) also found that local stocks reach 1.01kg head^{-1} at an age of 6 months.

The mean fresh weight of crop contents of the experimental pullets and cockerels was 21.8 and 20.2 g, respectively (Table 1). This result indicated that the mean fresh weight of the crop content of the males was about 93% of the mean fresh weight of the crop of the females, indicating that females are better scavengers than the males. Unfortunately however, there was no statistically significant difference between the pullets and cockerels in mean fresh weight of crop content (df is 1 and the p value of 0.8). Moreover, there was no significant difference (p-value of 1) in the composition of the crop content between the experimental males and females (Table 1).

Table 1: Major components of the crop content of the experimental chickens

Items	Pullets	Cockerels
Mean live weight (kg)	1.12±0.15[b]	1.4±0.12[a]
Mean weight of fresh crop content (g)	21.8±15.16	20.2±10.82
Major components of crop contents (%)		
Grains (maize, sorghum and teff)	38	36
Kitchen waste (cooked pepper and enset)	15	15
Green forage(grass and leaves)	17	20
Insects/worms (worms, ants and small snail)	28	27
Others (sand, soil and unidentified ingredients)	2	2

[ab]Means in the same row for each parameter with different superscripts are significantly different ($p<0.05$)

The result of this study showed that, the major scavenge able feed resources base of the study area comprises of cereal grains, green forages, insects/worms and kitchen wastes, all of which showed some sort of variation between the crop content of individual birds. Cereal grains comprised the highest proportion (38%) of the crop content of the experimental chickens, without showing significant difference (df = 1, $p>0.05$) between the male and female experimental chickens. Among the cereal grains, maize constituted the largest proportion of the crop contents followed by sorghum, both of which are widely grown staple food in the study area. Moreover, both maize and sorghum are good source of energy for poultry feeding. The results of this study tend to indicate that teff is a crop of less economic importance in the study area compared to maize and sorghum. This study was conducted in November, characterized by the early phase of dry period in Ethiopia. November belongs to the season of ripening and harvesting of almost all food crops in general and cereal grains in particular in Ethiopia. The results of this study is in agreement with that of Momoh *et al*. (2010), who observed the highest proportion of cereal grain(maize, rice, sorghum and millets) in the crop content of scavenging chickens in the late dry season (January-March) within Makurdi Benue community of North Central Nigeria.

Insects, worms, ants and small snails were found to be collectively accountable for about 27.5% of the crop content of the experimental chickens (Table 1), followed by (28%) and (17%) insects/worms and green forages respectively and Kitchen waste constitutes the remaining 15% of the crop content. distance from the house or as a backyard while teff is grown far from their home since it needs large area. In this study, insect/worms constitute 28% of the crop content of the experimental chicken. This can also be attributed to the period of the study conducted. Moreover, Momoh *et al*. (2010) reported insects/worms formed significant ($p<0.05$) component of the crop of birds, during early and late rainy seasons as compared to the early and late dry seasons and in agreement to current study. They were also found more (df = 1, $p<0.05$) in the crop of pullets than cockerels.

The results of this study also indicated that green forages (grass and leaves), is accountable for about 17% of the crop content of the experimental chickens. When compared to the other categories (grains and insects/worms) the green forage content of the crop content was very low which due to the seasonality of such plants which grows during the wet season. Similarly, Momoh *et al*. (2010) reported green forages were more predominant ($p<0.05$) in the crop contents during early rainy season than all the other seasons.

Kitchen Waste comprises of 15% of the crop content of the experimental chickens. Cooked pepper and enset (*E. ventricosum*) were the two kitchen waste commonly identified within the crop content of the experimental chickens. This could be attributed to the livelihood of the community. Generally Jimma zone can be classified in to two livelihood zones namely, Jimma-Ilubabor coffee, cereals and chat (JCC) LZ including (Gomma, Manna Gachi and Chora districts in Jimma and Ill Ababora administrative zones) and Nadda-Gilgel Gibe maize, teff and sorghum (NMT) LZ including (Seka Chekorsa, Dedo, Omonada and Sekoru districts). The NMT LZ is characterized as a mid-land, mixed agricultural, moderately productive, food sufficient area. Crops include teff, maize, sorghum, coffee, chat, pepper. Coffee, chat and pepper are produced by the wealthier groups. Livestock sales (cattle and shoats) supplement crop income. Poorer groups grow enset and get some income from labor (agricultural and construction) which can be the reason for the availability of enset and pepper in chickens crop.

Chemical composition of the crop contents: The results of the laboratory chemical analysis of the crop content of the experimental chickens are shown in Table 2. With the exception of dry matter content, there was no significant difference between the experimental chickens in the chemical compositions of the crop contents. The mean DM of crop contents was 93.47%. The dry matter content showed significant $p<0.05$ variation between the crop content of pullets and cockerels. The mean DM content of oven dried crop contents was 94.18% for pullets and 92.87% for cockerels. The main reason for the higher DM content of pullets crop content, which were at early stage of egg production, might be attributed to the high proportion of grains in their crop

Table 2: Chemical composition of the crop content of experimental chickens

	Type of birds		
Chemical composition (%)	Pullets	Cockerel	p-value
Partial dry matter	54.11^{a}	47.65^{a}	0.4774
Actual dry matter	94.18±0.71^{a}	92.87±0.4^{b}	0.0027
Ether extract	4.11±0.55^{a}	3.74±0.71^{a}	0.49
Crude fiber	11.92±5.19^{a}	11.07±7.63^{a}	0.73
Crude protein	10.46±2.63^{a}	9.16±1.58^{a}	0.29
Ash	22.86± 3^{a}	22.15± 2^{a}	0.48
Nitrogen free extract	44.73±7.8^{a}	47.46±9.82^{a}	0.59
Gross energy (kcal kg^{-1} DM)	3340.80±108^{a}	3282.70±61.4^{a}	0.24
Metabolizable energy (kcal kg^{-1} DM)	2023.00±398^{a}	2082.80±855^{a}	0.87
Calcium	1.26±0.59^{a}	0.73±0.32^{a}	0.065
Total phosphorus	0.66±0.13^{a}	0.68±0.04^{a}	0.82

^{ab}Means in the same row for each parameter with different superscripts are significantly different ($p<0.05$)

contents. The result of this study is similar to that of Momoh *et al.* (2010), who reported significantly ($p<0.05$) higher proportion of grains in the crop contents of pullets as compared to that of cockerels. It was also reported that the higher proportion of grains in the crop content of pullets might be a reflection of the preferential treatment given to the adult birds in grain supplementation by the local people. They believe that since the layers lay eggs or rear the chicks, they should have more feed.

The mean crude protein content of the collected crop content was found to be about 9.76%. The result of this study also showed that crude protein content of the crop content was 10.46 and 9.16% for, respectively. The protein requirement of high producing laying hens varies from 16-18% of the diet, to meet the needs of egg production, maintenance and growth of body tissues and feather growth but this also depends on the energy content of the feed (Dessie, 1996). This is higher than the result obtained by Dessie and Ogle (1996), the mean Crude Protein (CP) in the crop contents is $9.1\pm2.3\%$. However, both results are below the requirement of local laying hens. Similarly, Kingori *et al.* (2003), in Kenya reported that the CP requirements for indigenous chickens between 14 and 21 weeks of age is 160 g kg^{-1}. In which, the calculated crude protein content will be 91.6 g kg^{-1} which is lower than there requirement. The low protein values in cereal grains and their by-products could have been associated with the high fiber content in these feedstuffs. High fiber content has been also reported to have diluents effect on the grains as whole and reduces the energy and protein value proportionally (McDonald *et al.*, 2002).

Fat is usually added to the feed for meat-type poultry to increase overall energy concentration and in turn, improve productivity and feed efficiency. Ether extract content of the crop content of the experimental chickens was 4.11 and 3.74% for pullets and cockerels respectively while the crude fiber content was 11.92 and 11.07% for pullets and cockerels. Similarly, Momoh *et al.* (2010) and Rashid *et al.* (2005) reported higher percentage composition in CF but lower percentage composition of EE from crop content of the experimental chickens in Nigeria and Bangladesh, respectively. This can be attributed to the availability of fat reach feed in the area since oilseeds are not produced in Seka Chekorsa district.

The NFE represents soluble carbohydrates and other digestible and easily utilizable non-nitrogenous substances in feed, which is important for chickens, since they cannot utilize crude fiber efficiently as a energy yielding nutrient. The NFE content of the crop of the experimental chickens are also shown in Table 2. Mean percentage composition NFE recorded from the crop content of the experimental chickens in this study was 46.2. This value is lower than that of (68.8%) reported by Rashid *et al.* (2005) from scavenging crop content of chickens in Bangladesh. Similarly, Mwalusanya *et al.* (2002) and Momoh *et al.* (2010) reported higher NFE content from crop content of experimental chickens in Tanzania and Nigeria, respectively.

The calculated metabolizable energy content of the crop content of the experimental chickens was 2023 and 2082 kcal kg^{-1} for pullets and cockerels, respectively. In Nigeria, Momoh *et al.* (2010) reported 2352 and 2598 kcal kg^{-1} for layers and growers and also in Bangladesh, Rashid *et al.* (2005) reported ME content to be 2781 and 2755 kcal kg^{-1} for layers and growers, respectively. In which both results were higher than this study. Similarly, Dessie (1996) and Ukil (1992) reported higher ME. Energy is not a nutrient but a property of energy-yielding nutrients when they are oxidized during metabolism. Energy is the fuel that keeps the many different body functions operating, every minute of the day. It is a vital feed component, a costly feed component and the most wasted of the feed components. Especially, in the case of indigenous chickens most of the metabolizable energy is lost due to the movement of long distance to find feed. Of 4,000 kcal provided in 1 kg of this particular diet, 2,900 kcal are capable of being metabolized by the hen and about 2,300 kcal are available for maintenance and transfer into body tissue and egg (net energy) (Fraps, 1946; Hill and Anderson, 1958; Titus, 1961) cited in NRC (1994). The relative amounts of both Metabolizable and net energy will of course, vary with the composition of the feedstuffs in the diet. Other factors, such as the species, genetic makeup and age of poultry, as well as the environmental conditions, also influence the precise distribution of dietary energy into the various compartments (NRC, 1994).

The total ash content of the crop content obtained from the current study was 22.86 and 22.15%, respectively, for pullets and cockerels. Which do not show a significant difference between bird types. Similarly, Rashid *et al.* (2005) also reported no significant difference between bird types 12.4 and 12.3% for layers and growers, respectively. While, Momoh *et al.* (2010) reported ($p<0.05$) significant difference 23.33 and 18.98% for layers and growers, respectively. However, the amount of ash from the crop content is higher in the current study. This can be attributed to the inaccurate quantification of nutritional entities when using proximate analysis which include sand and other inorganic elements of organic origin e.g., P and S from proteins. Calcium and phosphorus are mainly required for the growth and development of the chicken skeletal system. Furthermore, laying hens require calcium and phosphorus for egg production activities. The mean calcium content of experimental chickens of this study was1.26 and 0.73% for pullets and cockerels, respectively while the Phosphorus content of the experimental chickens was 0.66 and 0.68 for layers and cockerels. The result of this study was higher than the calcium (0.9%) content of the crop content of scavenging chickens of the central high land of Ethiopia reported by Dessie and Ogle (2000). The result of this study was also higher than the calcium (0.75%) and phosphorus (0.37%) content reported by Mwalusanya *et al.* (2002) from a study conducted in Tanzania. Rashid *et al.* (2005) reported 0.46 and 0.336% of phosphorus for layers and growers from crop content of scavenging chickens from a study conducted in Bangladesh. (Momoh *et al.*, 2010) reported phosphorus content of 0.21 and 0.45% from scavenging layers and growers from an experiment conducted in Nigeria, the value of which were lower than that obtained in the current study. However the calcium content was lower the result 1.32% reported by Momoh *et al.* (2010) and Rashid *et al.* (2005). Relatively higher calcium and phosphorus content of the experimental chickens might be due to the availability of calcium in forages and phosphors in soil.

CONCLUSION

The results of this study revealed that the nutrient content of the scavenging feed resource base of Seka Chekorsa district is below the requirements of the scavenging local chickens. This may be attributed to the lack of knowledge about the importance of supplementary feeding or absence of credit for the poultry sector. The energy and protein content seems to be critically deficient in the scavenging feed resource base of the district and this may be due to the macro requirement of the nutrients. Therefore, the urgent need of developing awareness and a basic daily supplementary ration with the use of locally available feed ingredients is very critical.

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